

## **SYSTEM AND METHOD FOR PROVIDING TALKER ARBITRATION IN POINT-TO-POINT/GROUP COMMUNICATION**

### **FIELD OF THE INVENTION**

**[0001]** The present invention relates generally to communication systems, and more particularly, to a system and method for arbitrating between speakers in a half-duplex communication system.

### **BACKGROUND OF THE INVENTION**

**[0002]** Press-to-talk over Cellular (PoC) makes two-way radio service possible over a cellular network and is capable of providing direct one-to-one and one-to-many voice communications service to users of cellular telephones or other mobile communications devices. Calls are started by pressing a button (e.g., a talk button) on the cellular telephone. Press-to-talk over Cellular is based on one-way (half-duplex) communications – while one person speaks, the other(s) listen. When the person who is speaking releases the button, transmission stops and another person can press their talk button to gain the floor. Thus, by pressing the talk button, speakers can take turns responding to each other.

**[0003]** Conventional press-to-talk systems operate on a first-come first-served basis. Since the communications are half-duplex, if person A presses his talk button while person B is speaking, person A's microphone will not be activated, and person B will control the floor as long as his talk button is depressed. Thus, person B cannot be interrupted. Once person B releases his talk button, another speaker (the first speaker to activate his talk switch) can take the floor by pressing his talk button.

**[0004]** In the current usage of a PoC service, participants in a PoC are required to use a tactile scheme to assert floor control to acquire a talking status. The acquisition of the floor

or talking status is referred to as talker arbitration. The use of a tactile scheme is not a natural step in the semantics of human conversation, whether in a point-to-point conversation or in a group conversation. A tactile scheme, whether in the form of a dedicated push button on a wireless mobile communication device or in the form of a programmable key on the user interface of a wireless mobile communication device, is not convenient in the context of natural human conversation.

**[0005]** Accordingly, there is a need for a system and method for talker arbitration that is based on a facilitation of the natural dynamics associated with a face-to-face conversation. Further, there is a need for a system and method for talker arbitration that removes the need for a user to push a separate button on the handset before commencement of speech, which is not a natural component of face-to-face conversations.

## **SUMMARY OF THE INVENTION**

**[0006]** A system and method for providing talker arbitration in a half-duplex communication system such as a Press-to-talk over Cellular (PoC) system. The system and method can be used to allow a user to interrupt another user who currently has floor control. The system and method also removes the need for a user to push a separate button on the handset before commencement of speech, which is not a natural component of face-to-face conversations.

**[0007]** One embodiment of the invention is based on a facilitation of the natural dynamics associated with face to face conversation, where the amplitude of a speaker's voice is often used to gain floor control. This capability advantageously allows a user who is intending to speak to interrupt a user who currently has floor control. By basing talker arbitration at least partially on the amplitude of the speaker's voice, the invention removes the need for a user to push a separate button on the handset before the commencement of speech.

**[0008]** One embodiment of the invention is a method for talker arbitration. The method comprises receiving a speech energy level of a current talker in a communication session,

receiving a speech energy level of a prospective talker, selecting the prospective talker if the speech energy level of the prospective talker is higher than the speech energy level of the current talker, and granting the selected prospective talker floor control of the communication session. By selecting and granting the prospective talker floor control based on the prospective talker's speech energy level, the present invention removes the need for the prospective talker to push a button on a communication device.

[0009] In a related embodiment, the method further comprises receiving a static priority level of the current talker and receiving a static priority level of the prospective talker. The selection of the prospective talker can be based on both the speech energy level and the static priority level of the prospective talker in comparison to the speech energy level and the static priority level of the current talker. In another related embodiment, the method further comprises receiving a dynamic priority level of the current talker and receiving a dynamic priority level of the prospective talker. The prospective talker can be prevented from gaining floor control if, for example, the number of times the prospective talker has been granted floor control exceeds a threshold.

[0010] One embodiment of the invention is a system for talker arbitration. The system comprises a first mobile station associated with a current talker in a communication session, a second mobile station associated with a prospective talker, and a server, connected to the first and second mobile stations. The server is adapted to enable one of the first and second mobile stations to transmit based on speech energy levels respectively received from the first and second mobile stations.

[0011] In a related embodiment, the server is adapted to receive respective static priority levels of the current talker and said prospective talker. The server can enable one of the first and second mobile stations to transmit based on the speech energy levels respectively received from the first and second mobile stations, and further based on the respective static priority levels of the current talker and the prospective talker. In another related embodiment, the server is adapted to maintain respective dynamic priority levels of the current talker and the prospective talker. The server can prevent the prospective talker from gaining floor

control if, for example, the number of times the prospective talker has been granted floor control exceeds a threshold.

## **BRIEF DESCRIPTION OF THE DRAWINGS**

[0012] A more complete understanding of the present invention and its advantages will be readily apparent from the following Detailed Description taken in conjunction with the accompanying drawings. Throughout the accompanying drawings, like parts are designated by like reference numbers and in which:

Fig. 1 is a schematic illustration of a cellular network in accordance with the present invention;

Fig. 2 is a block diagram illustrating a protocol reference model for a network in accordance with the present invention; and

Fig. 3 is a flow diagram illustrating a method for talker arbitration in accordance with the present invention.

## **DETAILED DESCRIPTION**

[0013] Fig. 1 schematically illustrates a representative environment of the present invention. A first mobile station 100 (e.g., a Press-to-talk over Cellular mobile phone) is wirelessly connected to a first base station 105 via a first radio frequency (RF) network (e.g., a cdma2000 network). The first base station 105 is connected to a base station controller (BSC) 110, typically via a wire-line, such as a T1 line. The base station controller 110 is configured for connecting to and controlling multiple base stations 105. The base station controller 110 is connected to a Packet Control Function (PCF) 115 and to a Mobile Switching Center (MSC) 120.

[0014] The PCF 115 is connected to a packet data serving node (PDSN) 130 via Radio Protocol (RP). The PDSN 130 is connected to a core network 135, including a Press-to-talk over Cellular (PoC) server 140, typically via a wire-line. The core network 135 is connected to a communications network (e.g., the Internet) 150.

**[0015]** A second mobile station 160 (e.g., a Press-to-talk over Cellular mobile phone) is wirelessly connected to a second base station 165 via a second radio frequency network. In the illustrated embodiment, the second radio frequency network is not necessarily a cdma2000 network, but can utilize another type of wireless access technology. The second base station 165 is connected to the communications network 150 via a number of intermediate devices (not shown) to allow the second mobile station 160 to communicate with the first mobile station 100.

**[0016]** A Radio Access Network (RAN) protocol is used for transporting traffic from base stations 105 to the base station controller 110, between base station controllers (not shown), and between the base station controller 110 and an associated mobile switching center 120. While the representative environment has been described in the context of a Press-to-talk over Cellular system using a cdma2000 network, the present invention can be used to advantage in any half-duplex communications network.

**[0017]** Fig. 2 illustrates a protocol reference model for a cdma2000 based access network. in accordance with the present invention. The physical layer and link layer protocols would be different for other wireless access technologies. For interoperability, the protocols at the network layer and above are based on open standards. In this protocol model, Press-to-talk over Cellular (PoC) call control is performed via the Session Initiation Protocol (SIP), and the PoC media streams are conveyed over the Real Time Protocol (RTP), User Datagram Protocol (UDP) and Internet Protocol (IP).

**[0018]** The protocol stack for the mobile station 100, radio access network, packet data serving node 130 and Press-to-talk over Cellular (PoC) server 140 are shown in Fig. 2. At the top of the protocol stack is the Session Initiation Protocol (SIP) which provides for call control between the mobile station 100, the PDSN 130 and the PoC server 140. The PoC data streams are then conveyed between the mobile station 100, the PDSN 130 and the PoC server 140 via RTP/UDP/IP.

**[0019]** At the link layer, the mobile station 100 communicates with the PDSN 130 via the point-to-point protocol (PPP), and with the radio access network (RAN) via the link access control (LAC) and the medium access control (MAC) protocols. At the physical layer, the mobile station 100 communicates with the radio access network via the Airlink protocol.

**[0020]** The radio access network (RAN) communicates with the PDSN 130 via radio protocol (RP) at the link layer, and via any number of protocols at the physical layer depending on the physical interconnections between the RAN and the PDSN 130.

**[0021]** By employing the protocol model, communications between the mobile station 100 and the PoC server 140 may be carried out independent of the types of physical interconnections therebetween. The PoC server 140 can grant the PoC session floor to a participant mobile station 100 based on the participant's speech energy level as carried in the RTP payload, and optionally, based on the participant's dynamic and/or static priority levels.

**[0022]** Fig. 3 illustrates a flow diagram of a process for talker arbitration in accordance with the present invention. The process allows a participant in a PoC session to assert and acquire control of the floor based, at least in part, on the participant's speech energy level. The process includes configurable options whereby a PoC server can grant a PoC session floor based on a dynamic priority level and a static priority level. These configurable options can be applied in conjunction with the PoC participant's speech energy level for talker arbitration. This has the advantage of facilitating a fair scheme for talker arbitration while enhancing user experience.

**[0023]** The process starts at step 300. In step 304, the PoC session is in progress. In step 308, the process checks the speech energy levels of prospective talkers who are attempting to gain the floor and ranks the prospective talkers in order from highest to lowest based on their speech energy levels. In one embodiment, the prospective talkers include the current talker, if one of the PoC session participants currently has floor control.

**[0024]** In one embodiment, the speech energy level is encoded based on a negotiated voice codec in use in a PoC session. In a cdma2000 PoC session, for example, an Enhanced Variable Rate Coding (EVRC) codec is a typical example of an applicable codec since it is designed for efficient coding and good Mean Opinion Score (MOS) for delivery over low bandwidth wireless links. In other PoC sessions, other algorithms may be used to extract the speech energy level of a talker based on the specific codec in use in the PoC session.

**[0025]** Then, in step 312, the process selects a prospective talker with the highest (or next highest) speech energy level. By selecting prospective talkers based on the speech energy level, the present invention allows a participant in a PoC session to assert and acquire control of the floor based on the speech energy level of the participant. The present invention thus avoids the unnatural tactile scheme currently in use in PoC service.

**[0026]** In optional step 316, the process determines whether the prospective talker has the highest priority among the PoC session participants. The priority level can, for example, be based on a weighted function of the speech energy level and the static priority level of a PoC session participant. The weighted function may, for example, allow a PoC session participant with a slightly lower speech energy level, but a higher static priority level to have access to the floor. In one embodiment, the static priority level assigned to a PoC session participant may be based on, for example, the PoC session participant's subscription profile.

**[0027]** If the prospective talker does not have the highest priority level, (No in step 316) the process returns to step 312 and selects the prospective talker with the next highest speech energy level. If the prospective talker does have the highest priority level, (Yes in step 316), the process continues to step 320.

**[0028]** In step 320, the process determines whether the number of times that a prospective talker has been granted the floor exceeds a threshold set at the PoC server. Comparing the number of times that a prospective talker has been granted the floor to a threshold number thus allows the present invention to avoid a talker having a high speech energy level from dominating the conversation. If the number of times the prospective talker has been granted

floor control exceeds the threshold, (Yes in step 320) the process returns to step 312 and selects the prospective talker with the next highest speech energy level. If not, (No in step 320), the process continues to step 324 wherein the prospective talker is granted the floor by the PoC server. In step 328, the selected talker's floor grant count is incremented. In step 332, the PoC session is in progress as the talker maintains the floor. If there are prospective talkers while the current talker has the floor, the process continues to step 308.

**[0029]** In step 336, the process determines whether there are at least two participants still engaged in the PoC session. If so, (Yes in step 336), the process returns to step 332. If not (No in step 336), there are not at least two participants engaged in the PoC session and the process ends at step 340.

**[0030]** In one embodiment of the present invention, the selection of a particular talker for floor control from among a number of prospective talkers can be based on the prospective talkers' speech energy levels. However, since some PoC session participants may naturally speak louder than others, the present invention advantageously provides an override mechanism to avoid the same PoC session participant always being selected and given floor control.

**[0031]** In one embodiment, the PoC server 140 can assign a dynamic priority level to a PoC session participant based on the number of times that the PoC participant has been granted the floor. The dynamic priority level assigned to a PoC session participant can be made inversely proportional to the number of times that the PoC session participant has been granted the floor previously. Thus, as each time a particular PoC session participant gains floor control, the PoC session participant's dynamic priority level is reduced. In one embodiment, selection of a particular talker for receipt of floor control can be made based on a weighted function of the speech energy level and the dynamic priority level of the prospective talkers.

**[0032]** In one embodiment, the PoC server 140 can assign a static priority level to a PoC session participant based on the PoC session participant's subscription profile. For example,



a team leader may be given a higher static priority level than the other team members.

Selection of a particular talker for receipt of floor control can be made based on the speech energy level and the static priority level of the prospective talkers. In a related embodiment, selection of a particular talker for receipt of floor control can be made based on a weighted function of the speech energy level and the static priority level of the prospective talkers.

**[0033]** By using the dynamic priority level and/or the static priority level in conjunction with the speech energy level, the present invention can allow floor control to pass from one session participant to another based on the natural dynamics associated with face-to-face conversations.

**[0034]** Although the present invention has been fully described by way of examples and with reference to the accompanying drawings, it is to be understood that various changes and modifications will be apparent to those skilled in the art without departing from the spirit and scope of the invention. Therefore, unless such changes and modifications depart from the scope of the present invention, they should be construed as being included therein.